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Rocks and Minerals

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Published by

PETER ZODAC

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Natural size photograph of a Brazilian diamond in a matrix that is unique.

ROCKS AND MINERALS

Published quarterly, at Peekskill, N. Y., and devoted chiefly to rocks, minerals, ores, crystals and gems, in the interest of the General Collecting Public.

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EDITORIAL

"Rocks and Minerals" extends to each and every subscriber and reader a Merry Christmas and a Happy New Year.

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The hearty co-operation and generous support given the magazine by its loyal subscribers cannot be passed by without giving them due credit. Suggestions, criticisms, new subscriptions, articles, advertisements, etc., are pouring in every week, not only from the many states in the Union, but also from different parts of the world as well. "Rocks and Minerals" now circulates in almost every state in the Union, as well as in Alaska, Canada, Hawaii, Philippines, Mexico, Canal Zone, Porto Rico, Barbadoes, Martinique, France and England. The magazine is here to stay and before long it will come out as a monthly.

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It is the desire of the publisher to make "Rocks and Minerals" a standard magazine on rocks, minerals, ores, crystals, and gems. In order to accomplish this aim, we will try to add in each issue, a new feature to improve the magazine and please and interest the subscribers. In this issue—two—new features have been added—1—A department on Minerals of the Rarer Elements—which will be conducted by O. Ivan Lee, of Jersey City, N. J. Mr. Lee, is a well-known authority on these minerals. His article in this issue is not only interesting but of timely importance. 2—Paleontology Department—conducted by Benjamin T. Diamond, President of the Geology Club of City College of New York. Mr. Diamond is an enthusiastic collector of fossils and is much interested in assisting, not only "Rocks and Minerals" but the subscribers as well who may desire to learn a little about fossils.

In the March issue another department will be added—A Beginner's Department. This department should be of chief interest to beginners, Boy Scouts, Girl Scouts, teachers of nature study, etc. This department will be in charge of Mrs. Ilsien Nathalie Gaylord, Boston, Mass. To many of the subscribers, Mrs. Gaylord, needs no introduction. She has been connected with many large boy and girl Scout camps in the East and West, with schools, etc., teaching and lecturing on Nature Study. Mrs. Gaylord has not only travelled extensively over the United States, coming in contact with various schools, camps, etc., but has also had charge of a department on general nature in a prominent publication. Another feature that may be added is a—Prospector's Department—of chief interest to prospectors. There are thousands of prospectors thruout Western U. S., Canada, Alaska, Australia, etc., who would gladly welcome such a department (many of them in Alaska, Canada, and U. S. are subscribers.) A crystal department and a gem department may also start in the next issue, providing some one competent can be obtained to take charge. Subscribers who would be interested in assisting "Rocks and Minerals" with these departments are kindly requested to write the Editor.

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Many suggestions have been received for which we are grateful. Some of these we will pass on to our subscribers. Mr. C. S. Mason, Toledo, Ohio, suggests that short personal articles by subscribers on—How I obtained my choicest specimen—where and when—would prove interesting. This is a good idea. Subscribers interested are requested to send in their notes and they will be published in the order received under—How I obtained my choicest specimen—column. Mr. Staver, whose interesting article on the Brazilian diamond appears in this issue, suggests that a list of the best museums of minerals in the cities, thruout the country, should appear in "Rocks and Minerals" as many subscribers would be interested in visiting such museums, especially, those who may live near by. Subscribers are requested to send in names and other information about museums in their cities, which will be published from time to time.

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A suggestion that has been brought to our attention is the possibility that many subscribers may be stamp collectors. Such subscribers, when sending in orders for minerals, are requested to mention this fact—so stamps of Philatelic value may be used on all packages sent them.

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Beginning with this issue the subscription price of "Rock and Minerals" will be advanced to $1 per year in U. S. and Possessions, and $1.25 for foreign countries. We believe this raise is necessary as the magazine will be enlarged and improved. Subscribers who have paid-up for 2, 3 and even 5 years, are to be congratulated on their foresight, as no extra assessment will be charged. When the magazine becomes a monthly (possibly next year) it may be necessary to increase the subscription again. Subscribers are advised to take advantage of the low rate now, $1.00 per year, and send in their subscriptions for at least 2 years.

MONTANA SAPPHIRES

By A. J. Harstad

The existence of sapphires in Montana has been known since the early '80s and probably before. They were first noticed in placer gold operations and undoubtedly thousands of carats thrown away before their value was realized.

The three principal localities in this State are, Yogo Gulch in Fergus County, where the famous Yogo or Cornflower blue gems are obtained, Rock Creek, West of Anaconda, and a district beginning about 20 miles East of Helena on the Missouri River, and down the river from there for about 20 miles. In the two last named localities the sapphires are found in the gravels only and are recovered in a manner similar to placer gold mining. In these two localities the sapphires run in color mostly to light blue, light green, various shades of yellow, pink and colorless. The Rock Creek gems are generally better in color than those of the Missouri River. They occur mostly as Hexagonal prisms with diameter and length about equal and are of rough surface. As these are gravel deposits many of them occur as rolled pebbles. The crystals seldom run over one-half inch and a crystal that will cut a 5 carat finished gem is a large one.

There is no regular mining for sapphires on the Missouri River now but the Rock Creek deposits are being worked. These variously colored sapphires when in good quality make really beautiful gems. The stones not fit for cutting are used for various industrial and scientific purposes such as watch jewels, bearings for delicate scientific instruments, dies for drawing various metals, etc. The proportion of gems to mechanical stones is rather low here but the opposite is true of the Yogo deposits.

In these districts many sapphires are found with uneven distribution of color in a single crystal. Some times this is merely a variation in shade and some times two distinct colors. The latter are called "Pinto" sapphires by the people of the locality. This variation in color calls for special knowledge on the part of the cutters to bring out the real beauty of the gem and some of the best work in this line is done by lapidists of this State.

The Yogo deposits as well as the others just described were opened in the course of placer operations, but unlike the others the Yogo deposits netted only a few Hundred Dollars in gold. The blue sapphires however, have kept this property in operation continuously for nearly thirty years. The Yogo gems are unrivalled among the blue sapphires of the world and excel the Oriental in color, radiance and matching. They are the true cornflower blue sapphire color and bring a much higher price in the gem markets than the Missouri River or Rock Creek gems. The latter however, in good colors find many supporters who consider them more beautiful and pleasing to the eye than the blue, a contention to which I most heartily subscribe.

The Yogo sapphires occur in place and the lead is nearly five miles long. The property is owned and operated by The New Mine Sapphire Syndicate. The lead has a depth of over 1,200 feet and an average width of 8 feet and is worked by levels from a shaft. The rock is handled in cars of about 18 cu. ft. capacity and 40,000 cars is about a year's work. The ore is dumped from the cars upon a wooden washing floor of about 100,000 sq. ft. area. Here it remains for a long period while Nature assisted by sprinklings with water and steam, causes the disintegration of the rock through out which the sapphires are sparingly distributed. The breaking down of the rock frees the sapphires from the matrix and in the early summer the flumes are turned against the

rock pile and the water washes it through the sluice boxes. The larger rock not broken down is returned for further weathering and the pay dirt is washed over the riffles from which the sapphires are cleaned up. The tailings are washed against a dam to weather for another season and go through sluice boxes again. This process is repeated against a second and third dam and as cold weather prevents any washing in the winter time it takes four seasons or nearly four years from the time a car full of rock leaves the shaft until the last sapphire is extracted. No sapphires are sold locally, all the rough gems being shipped to England and Continental Europe for cutting.

Red sapphires or the true corundum ruby have been found in Montana but very few in number and of such small size as to be of no value as gems. The stone commonly called "Montana Ruby," if it is a mined gem and not an imitation, is most likely garnet from the Alder Gulch district.

Government Bulletin 269 "Corundum and its occurrence and distribution in the United States," by Joseph Hyde Pratt, is available for a few cents from Superintendent of Documents, Washington, D. C. This is a 175 page book and covers Sapphire deposits in Montana and other states.

GEMS FOUND IN MAINE

By C. D. Marble

The state of Maine is provided with a variety of gem minerals such as very few other states can equal. They are found mostly in or associated with, the coarse variety of granite, called pegmatite, and since this is also the source of the feldspar so extensively used in the manufacture of pottery and various other things, it naturally follows that we have a "happy hunting ground," already opened up for us. Of course one always hopes to discover a rich deposit which has not been worked, but the old mines, even after laying idle for twenty years, often give a rich assortment of gems if they are properly prospected.

The tourmaline, is of course, the best known of the Maine gems, and also it has the greatest variety of colors, not counting the black variety, which is useless. The green tourmaline varies from a pale shade to a deep olive green and usually has a tinge of yellow or blue, that is to say, the true grass or emerald green, is rare. The green and the blue are commonly very dichroic so that they must be carefully cut in order to display an even color. The blue or Indicolite, makes a very pretty stone, but like the green, has various shades. The pink tourmaline or Rubellite, brings a higher price than other varieties, so we must conclude that most people call it the most beautiful of the tourmaline gems. The colorless variety, called Achroite, and the yellow tourmaline, are found, but not frequently.

The different forms of beryl are more widely scattered and while they have not the range of colors possessed by the tourmaline, they make a more brilliant gem and do not chip as readily. The Aquamarine is the commonest of Maine gems and with its delicate blue tint makes a very pretty gem when cut. The golden beryl, not so plentiful, is more in demand. It comes in color from a rich orange to a almost clear white. The Caesium beryl is a pale blue, pinkish or even clear white, and makes a stone that is hard to tell from a diamond in artificial light.

Then there is the Chrysoberyl (no relation to the Beryl). Fortunate, indeed, is the one who finds a specimen fit to cut. The color is usually pale green or greenish-yellow. An occasional specimen is found in various places,

but it is considered rare. The Chrysoberyl is the hardest and the highest-priced of all Maine gems, and a cut stone is nearly equal to the Ruby or Sapphire, in durability.

Of the Quartzes, we have Amethyst, Cairngorm or Smoky, and the clear Quartz or Rock Crystal, in gem quality. Many of these are cut as gems but they do not command a very high price.

Garnets are plentiful, especially, Almandites (so called Iron Garnet) but seldom of gem quality. Some of the crystals are large, specimens up to three inches in diameter are often found. Cinnamon Garnets or Grossularites are also known, occasionally, some are found that can be cut as gems.

Topaz, of a pale blue or even colorless, has been found, chiefly in but one locality, which appears now to be exhausted.

Zircon is also known, but the pleasure of finding it in gem quality is yet to be realized.

Spodumene is plentiful in certain districts, but none is reported in gem quality, tho specimens that are fairly translucent are often found.

Phenacite is known but hard to find.

A few other varieties, like Sodalite and Beryllonite, have been found in small quantities (mostly too soft for gems), and so rare as to be practically non-existant, so far as mining goes at the present time.

The business of mining for gems alone does not usually pay in this state, altho single crystals have been sold for as much as $1,000, and in recent years, the contents of one pocket were sold for $3,200.

In conclusion we might say that the prospecting is good and by close study and hard work, one can still obtain results.

THE LURE OF MINERALS

"The layman who spends his leisure time in the study of minerals cannot help having a larger view of life and a keener appreciation of all that is pure and lovely. It is art in its truest sense. Their beauty, their form, their color, their chemical composition, their association and environment, all help to make minerals of unusual interest. Delving among the rocks in an endeavor to grasp from nature some of her marvellous secrets is a healthful diversion and cultivates the habit of closer observation and discrimination.

"It is not only the man trained in the science of the rocks who appreciates the wonders of the workings of nature as expressed in minerals. The layman whose hobby is the collecting and studying of minerals cannot help being an enthusiast because he is doing a thing for the love of it. Once a man becomes interested in mineralogy it is sure to cling to him for the rest of his life. Many men in their younger days develop an interest in minerals, but in the keen struggle for an existence, together with the care and attention necessary for family life, they are compelled to lay aside, temporarily, this interest. When in later years the struggle becomes less keen and the evening of this life is approaching, they turn again to their old comrades and find there the pleasures that are found only in the rocks.

"A crystallized mineral is the ultimate expression of nature in its inorganic kingdom; its relation to the rocks is the same as the budding flower is to the plant. We see in mineral crystals the continual struggle for perfection just as we see it in everyday life."

(Author unknown.)

NOTES AND NEWS OF MINERALS OF THE RARER ELEMENTS

(As listed in Cahen and Wootton's "Mineralogy of the Rarer Metals," second edition, 1920.)

By O. Ivan Lee

New Minerals

Loparite: a titanite of cerium, sodium and calcium; Kola Peninsula, Hibina Tundra, Lapland, Russia.

Fourmarierite: $PbO . 5UO_3 . 10H_2O$ or $PbO . 4UO_3 . 5H_2O$ or $(UO_2 Pb)O . H_2O$; Belgian Congo.

Some Differential Tests

1. Specimens labelled carnotite, hydrated vanadate of uranium and potassium, especially those from western localities having a waxy luster, are not infrequently in reality tyuyamunite, hydrated vanadate of uranium and calcium. They can be differentiated as follows: Detach a small **pure** fragment (free of earthy gangue) and heat strongly on a platinum foil or porcelain crucible cover. Carnotite blackens but does not fuse. Tyuyamunite blackens and melts to a jet enamel.

2. Ilmenite and columbite (tantalite) are often associated, and it is sometimes difficult to distinguish them in the absence of characteristic forms. Ilmenite, however, is magnetic enough readily to swerve the magnetic compass needle while columbite is quite without effect.

3. Monazite (massive and sand concentrate) and fluocerite (tysonite) exhibit the characteristic absorption bands of neodymium and praseodymium merely by examination by a strong reflected light (preferably sunlight) with a direct vision spectroscope.

Associated Minerals You May Have Without Knowing It

Manganotantalite: if your columbite or tantalite shows deep red internal reflections by a glass under a strong light, it is probably the variety rich in manganese known as manganotantalite.

Tengerite: found on gadolinite and perhaps on yttrialite as thin white coatings sometimes with radiated crystallization (microscopic).

Rogersite: occurs not uncommonly on samarskite as a thin white mammillary crust.

Zircons (microscopic): in the chrysoberyl matrix from Greenwood, Maine.

Cryolithionote: found occasionally imbedded in Greenland cryolite from which it may be told by its uneven fracture, perfect transparency and pure white color.

Minasragrite: found as a blue crystalline efflorescence on patronite, especially specimens which have been exposed to the air for several years.

Fernandinite: also found on patronite in minute aggregates of dull green crystals.

Fergusonite: Frequently associated with cyrtolite from Baringer Hill, Llano County, Texas. It is liver-brown and brilliantly vitreous.

RANDOM NOTES

The **rose beryl** found at Branchville, Connecticut, contains O.15% of cesium, expressed as chloride.

Higginsite, from the Higgin's Mine, Bisbee, Arizona, contains 1.97% of vanadium pentoxide.

The mineral originally described as **galenobismutite** from Falun, Sweden, and later thought to be a distinct species, **weibullite,** has been shown by mineragraphic examination to be a mixture. It contains about 13% of selenium.

Teallite (pufahlite) and **franckeite** both contain small percentages of germanium.

Molybdite is in reality **ferrimolybdite,** $Fe_2O_3 . 3MoO_3 . 7.5H_2O$. True molybdite, MoO_3. has as yet not been found in nature.

"Kentsmithite" is a miners' name given to dark ambiguous vanadium ores in western states, usually impregnating sandstone and sometimes accompanied by asphaltic material and uranium minerals of orange and yellow colors. It is not uncommonly **vanoxite.**

The hafnium content of zirconium minerals is roughly proportional to their radioactivity.

Crystals of **sperrylite,** arsenide of platinum ($PtAs_2$) and the heaviest mineral known (density = 10.60) aside from native metals, of unprecedented size have been found in the new Rhodesian platinum fields. Some of the cubes measure from ⅜ in. to ½ in. on an edge and one is reported in the British Museum measuring an inch! The value of the platinum in such a crystal would be $300.

According to International Critical Tables, the oldest radioactive mineral (as determined from the lead ratios) is uraninite from the Black Hills, S. D. The geologic horizon is given as Pre-Cambrian, the Pb percent as 15.24, the U percent as 66.90, the Th percent as 1.89 and the age as 1540 million years.

The same authority states that uraninite from Branchville, Conn., contains the largest amount of helium, no less than 21.0 cc.per g. (Note: This is released when the mineral is dissolved in acids, together with nitrogen.) The geologic horizon is given as Silurian (?), the U percent as 74.3, the Th percent as 5.72, and the age as 250 million years (400 as calculated from the lead ratio.)

First Collector—"I'm very much worried. I do not know what to give my nephew for Christmas."

Second Collector—"How old is your nephew?"

F. C.—"16 years."

S. C.—"That's easy—a year's subscription to "Rocks and Minerals."

A UNIQUE SPECIMEN

By W. H. Staver

The frontispiece is a natural size illustration of a unique specimen—a diamond crystal in a conglomerate matrix. The diamond, which is half-imbedded in the matrix, is a clear yellow gem, slightly less than two carats in weight, with the crystal edges well pronounced. The matrix is a conglomerate, and composed of cemented grains, of water-worn and rounded, quartz and spar.

This specimen was found some years ago in a stream-bed in Bahia, Brazil. As far as is known, there is no other specimen like it, it is worthy, therefcre, of a place in the best museums.

The specimen is now in the possession of a diamond importer, in New York, who does not appreciate its value and desires to sell it. Collectors who desire a really good specimen to add to their collection can secure more particulars by writing me, care of "Rocks and Minerals."

THE SLUICE BOX

Signs point to a revival of Mineral Collecting in this country. Loyal support of "Rocks and Minerals" will be one great factor in bringing this about.

Good mineral specimens will never be worth less money than they are today.

Can you think of a better way to increase the value of your own collection than by giving some boy a few dozen of your duplicates and some information and thus start a new collector.

"A rolling stone gathers no moss," but an open specimen case gathers lots of dust.

Some one has said "A good geologist is one who knows his own back yard." Why not have a small case displaying the various common rocks of your own community properly labelled?

"Old Bill" has a new name for the "Riding breeches, Leather puttee" Branch of the mining fraternity, specimens of which show up in our mountains every summer. He calls them "Mining Maggots."

Generally speaking a specimen is of little use to a fellow collector unless it carries proper name and location. Be sure this information accompanies specimens when selling or exchanging.

If a specimen is worth shipping it is worth proper packing. Orange wrappers, etc., make good packing, weigh little and cost nothing.

The other day "Old Bill" assayed a specimen of pyrite for a "Drylander" who came in all broken out with gold discovery rash. Bill told him it was pure Sulphide of Pick Ax handles and wouldn't run an ounce less than two thousand pounds to the ton.

THE GEOLOGY OF THE DISTRICT OF COLUMBIA

By Mr. Elra C. Palmer, of Washington, D. C.

So far as I have been able to ascertain no connected story of the geologic features of the District of Columbia, as revealed by quarries and excavations up to the present, has been contributed to any popular or scientific magazine. In response to the invitation of the editor, I shall endeavor to place before the readers of "Rocks and Minerals" a brief story of what Nature has done for this patch of the earth's surface.

This story will not be clothed in much technical language, nor will it claim to be absolutely accurate and complete; but it will occasionally stray beyond the boundaries of the District and will mention some of the able men who have, by searching, discovered how God worked here during the ages that are gone.

The District of Columbia, as almost every high-school boy knows, was an area of one hundred square miles lying on both sides of the Potomac river, at longitude 77 degrees west and just below 39 degrees north latitude, and was given to the General Government by the states of Maryland and Virginia as a cradle for the capital of the baby nation that had just been born. However, the General Government found out in a few years that the cradle was a little too large, and so gave back to Virginia in 1846, most of the approximately 36 square miles on the Virginia side of the Potomac river and confined its jurisdiction to the 64 square miles remaining on the Maryland side. This area now constitutes the District of Columbia.

The United States Geological Survey, which was established by act of Congress of March 3, 1879, naturally began observations of the geology of the District soon after its organization, and its publication of the investigations of N. H. Darton, F. D. Chester, George H. Williams, Dr. Bailey Willis and others, within the few years following 1879, form the basis of most of the information now in print on the subject. The opening of quarries and the cutting of streets through the hills abounding in the District, have been, of late years, fine opportunities for further perfection of our rather limited knowledge of the earlier years.

The crystalline rocks of the Piedmont plateau are in evidence at or near the surface in all of the northwestern part of the District and provide beautifully wild and rocky scenery where the Potomac river, Rock Creek and Piney Branch have cut deep gorges through these rocks in the course of ages. These rocks, formed evidently by the ancient furnace fires of the earth, are mostly granite, gneiss, granite-gneiss, and quartzite, and are quite micaceous and schistose in formation, in certain parts of the District.

(To be continued.)

IDENTIFICATION OF MINERALS

Free use has been made of standard books on Mineralogy as Dana's, Butler's, Brush-Penfield's, etc.

PART 2

In the last issue we mentioned the fact that every collector of minerals who desires to analyze his specimens, should have a laboratory of some sort, where this work can be done easily, conveniently, and correctly. A list of important apparatus and supplies, with uses, was also given.

Introduction: A mineral is a body produced by the processes of inorganic nature, having a definite chemical composition and, if formed under favorable conditions, a certain characteristic molecular structure, is exhibited in its crystalline form and other physical properties. A mineral must be a homogeneous substance, even when minutely examined by the microscope; further, it must have a definite chemical composition, capable of being expressed by a chemical formula. Altho usually solid, minerals may exist in a gaseous, liquid, or a viscid state. Water is a mineral that solidifies at 32 degrees F. and is converted into a gas at a temperature somewhat exceeding 212 degrees F. Petroleum, asphalt, and coal are minerals, altho coal is of undoubted vegetable origin.

Most rocks are mixtures of more than one mineral, usually so blended that the composition may be difficult to name and classify; for instance, granite, which is composed of three minerals-feldspar, quartz, mica or hornblende. There are a few rocks—like obsidian, limestone, and coal—that consist so nearly of a single mineral that they may be said to be composed of one mineral.

Nomenclature: Most of the names of minerals terminate in **ite.** Originally, most of the names terminated in **ites** or **itis,** these terminations were given to stones by the early Romans. In English, the s has been dropped and **ite** used for the singular, s being added to form the plural. In recent years, as new minerals are being discovered, it is customary to name such minerals after the discoverer; for instance, Torbernite, named after the discoverer Torbern; or after the name of a town or state where first found—Franklinite, after Franklin, N. J., Utahite, after the state of Utah; or after some famous person, as Goethite, for the German poet, Goethe, etc. Many minerals do not have the termination **ite;** for instance, quartz, garnet, gypsum, etc.; while the names of metals, gems, etc., that are a part of general literature, remain the same. Mica and feldspar, names equally old with quartz, refer to groups of minerals. Some minerals terminate in **ine;** for instance, serpentine, tourmaline, etc.

Identification of Minerals: There are three methods of proceedure in Identifying minerals: 1, by examining the physical properties; 2, by fire analysis; 3, by wet analysis.

Physical Properties of Minerals

The physical properties of minerals are: color and streak, cleavage, crystal form, feel, fracture, hardness, luster, odor, magnetic property, structure, specific gravity, taste, transparency, and tenacity. It is seldom that a mineral can be identified by any single one of these properties, it is by comparing several or oftentimes all of the properties that we can determine what the mineral is. For example, magnetite is black—but so are many other minerals; but we find on examining magnetite, that it is heavy, its hardness is 6, it has a black streak, metallic luster, attracted by a magnet, etc., which separates it very easily from many other black minerals.

1. Color and Streak: Minerals come in all colors, oftentimes the color alone is sufficient to identify a mineral. Epidote, for example, is commonly found in a peculiar pistachio-green color which no other mineral equals. Tho many minerals occur in all colors and their variations, nevertheless, color is a very important property in identifying minerals. A peculiar feature about color is—that it will often differ when the mineral is powdered. Hematite, for example, comes in deep red, deep black, grayish, and brownish colors, but whatever color is powdered, the color of the powder is **always** red. It is not necessary to powder a mineral to see if any change occurs in the color of the powder, this can be very easily determined by means of a streak plate. A streak plate is a piece of unglazed porcelain. The mineral to be tested is simply rubbed over the streak plate leaving a trail of color on the plate. The streak so made, is the color of the powder. As the plate is white, colored streaks show up very distinctly. The importance of streak is shown in the following example:—magnetite and chromite are two heavy black minerals that resemble each other very closely, and under ordinary conditions, cannot be told apart. Tho magnetite is strongly magnetic, chromite is often somewhat magnetic too, so this test is not enough. We find, however, that the streak of magnetite is always black, while that of chromite is brown. Here we have a very simple, and still a reliable, test. Hematites, also, are oftentimes identified, simply by their streaks. When a plate becomes covered with streaks, it can be easily cleaned with soap and water. The colors of a mineral are either **metallic or non-metallic;** the metallic are named after some familiar metal as copper-red, bronze-yellow, brass-yellow, steel-gray, lead-gray, iron-black, etc. The non-metallic colors are the ordinary colors, red, white, blue, green, black, etc.

2. Cleavage: Most minerals have certain directions in which they break, or split, when hit with a good blow; this tendency to break in such a way is called cleavage, and the plane along which the break occurs, is called a cleavage plane. There are different degrees of cleavage as follows:

Perfect or **eminent**—when obtained with great ease, affording smooth, shiny faces, as in calcite, mica, galena, etc.

Distinct—when obtained with ease, and yield fairly smooth cleavage faces, but neither so easy nor complete as perfect cleavage.

Indistinct—when obtained with some difficulty and the cleavage faces and angles not well defined.

Difficult—when obtained with great difficulty and the cleavage faces barely seen. Cleavage of this kind is very apt to be only in traces, that is, with a bit of cleavage face showing here and there.

Interrupted—when the cleavage face discontinues abruptly, only to be continued in another cleavage plane parallel to the first. This condition may occur in minerals having perfect or distinct cleavage.

The inferior degrees of cleavage are of themselves of no value in identifying minerals; but the absence of cleavage, or very poor cleavage, will some times serve to distinguish a mineral from minerals similar to it in appearance, but having more pronounced cleavage.

3. Crystal Form: When chemical compounds solidify from a state of fusion, solution, or vapor, they have a tendency to assume regular geometrical (polyhedral) forms bounded by plane faces; such forms are called crystals. The process of assuming this crystalline form is called crystallization. Different substances crystallize with greater or less ease according to their composition and physical condition; while the forms of crystals differ with different substances and with the same substances under different conditions, but usually each mineral has a definite crystallization, by which it may often be distinguished. There are thousands of different crystals but they are all grouped into six systems as follows: Isometric, Tetragonal, Hexagonal, Orthorhombic, Monoclinic, and Triclinic. Crystallography is a science by itself and is a little too long to go into detail now, nevertheless, as many minerals are found in crystal form, a knowledge of crytallography is of great importance in their identification. Collectors who desire to know more about this interesting subject, should get a good book on crystals. Butler's "A Manual of Geometrical Crystallography"—or Dana's "Minerals and How to Study Them"—are two very good books for beginners. Later on, when our Crystal Department gets organized, we will run a series of articles on crystal systems.

4. Fracture: is the surface obtained in breaking a mineral in any direction except along a cleavage plane. The different kinds of fracture are:

Conchoidal—when the mineral breaks so as to give a curved or shell-like surface. It is especially characteristic of amorphous substances, such as glass, and of minerals having a poor cleavage, such as quartz.

Even—when the fractured surface is fairly regular, though perhaps somewhat rough.

Uneven—when the fractured surface is irregular and rough.

Hackly—when the fractured surface is jagged and irregular like that of broken metal.

Splintery—when the mineral breaks in splinters or needles.

Earthy—when the mineral powders or falls to pieces when struck.

Fracture: is characteristic of a few minerals only, and then, like the inferior degrees of cleavage, is valuable to distinguish minerals from others having a similar appearance but a different fracture.

5. Hardness: There are many degrees of hardness among minerals, so, for convenience, certain well-known minerals have been selected, arranged, and numbered in the order of their hardness, thus forming a scale of comparison, as follows:

1—Talc	4—Fluorite	7—Quartz
2—Gypsum	5—Apatite	8—Topaz
2½—Finger nail	5½—Knife blade	9—Corundum
3—Calcite	6—Feldspar	10—Diamond

Any mineral in this scale will scratch all the minerals preceding it, and in turn, will be scratched by all the minerals following it. In testing an unknown mineral for its hardness, the mineral is carefully examined and a good sharp corner is taken and rubbed across a crystal face or a smooth cleavage face of one of the above standard minerals—say Feldspar. If the mineral makes no impression on Feldspar, it is softer than Feldspar and its hardness is less than 6. Apatite is next tried and if no impression is made on Apatite either, then the unknown mineral is softer than 5. On testing with Fluorite we find that the unknown mineral scratches Fluorite, perhaps with some difficulty, but nevertheless, it makes a distinct scratch. The hardness of the unknown mineral is, therefore, 4 or possibly 4½. MINERALS OF THE SAME

HARDNESS WILL ALWAYS SCRATCH EACH OTHER—that is—Calcite will always scratch another Calcite; Quartz will always scratch another Quartz, etc.

The Hardness Test is a very important one. All students are advised to secure a set of the standard minerals and practice with them until they become proficient in their use. An experienced Mineralogist can tell the hardness of a mineral, pretty closely, by means of his knife alone. All students are urged to practice considerably with a knife and learn the degrees of hardness this way. The following may be of some interest:

1—Generally has a soft and greasy feel, like Talc, Graphite, and Molybdenite; often soils the hands like Graphite; easily scratched by the finger nail and VERY easy by a knife.

2—Can be scratched easily by the finger nail, but not so easily as Talc. A knife scratches it very easily.

3—Cannot be scratched by the finger nail, but easily by a knife.

4—Scratched by a knife but not so easily as Calcite.

5—Scratched with some difficulty by a knife.

6—Cannot be scratched by a knife. Minerals of this hardness will scratch ordinary glass.

7—Scratches glass easily.

There are not many minerals that are harder than 7 (Quartz), but those that are include all the highly-prized gems as Emeralds, Rubies, Sapphires, Diamonds, etc.

The student should be careful, in testing an unknown mineral, by not disfiguring it too much. Always make your scratches, as SMALL as possible, and NEVER on the surface that is most noticeable, but ALWAYS place them where they will least show. Remember also, that a soft mineral will never scratch a harder mineral, but may leave its mark on it (Streak); while a hard mineral will always scratch a softer mineral, leaving a distinct scratch or groove. In case of a doubt, as to whether a mineral has scratched another or left its streak, the mark should be washed off—if it was a streak the mark will disappear, if it was a scratch, the scratch will be distinctly visible (under a magnifying glass). There are certain hard minerals, like Quartz (var. Friable Sandstone), or Opal (var. Diatomaceous Earth), that will fool a beginner, for a finger nail, oftentimes, seems to scratch them easily. This is due to the fact that these minerals are generally formed by an accumulation of very small grains, loosely cemented, consequently, in scratching such minerals, the grains are simply broken apart. No matter how friable such minerals may be, if their hardness is 6 or over, they will **always** scratch glass, thus showing their true hardness. Furthermore, minerals are constantly undergoing changes. Many are often found whose edges are changing (altering) into another mineral. In testing the hardness of an unknown mineral, the true mineral should be tested and not the altered mineral (which in most cases is considerably softer.)

6. Luster: is the reflection or shine a mineral gives when held in the light. Different degrees are noted as follows:

Metallic—is the luster of ordinary metals, like lead, copper, iron, etc. An imperfect metallic luster is described as **submetallic.**

Vitreous—is the luster of broken glass. This is the characteristic luster of Quartz. Imperfectly vitreous luster is described as **subvitreous.**

Resinous—is the luster of ordinary rosin. It gives the name of "Rosin Jack" to some varieties of Sphalerite.

Greasy—looks as if smeared with oil or grease, shown by some specimens of Quartz, Serpentine, etc.

Pearly—like pearl; frequently found in such minerals as Mica, Talc, and Gypsum, which are made up of very thin leaves, or layers.

Silky—like silk; fibrous minerals like Asbestos, Satin Spar, etc., have this luster.

Adamantine—is the luster of the diamond. This is a brilliant, almost oily luster, shown by some very hard minerals, as diamond, corundum, etc., but other minerals also have this luster.

Besides the different kinds of luster, there are different degrees of intensity of luster, depending on the clearness of the reflection. These are:

Splendent—when the surface is a perfect mirror reflecting light with great brillancy, and giving well-defined images.

Shining—when an image is produced, but not a clearly defined image.

Glistening—when there is a general reflection of light from the whole surface, but no image.

Glimmering—when the reflection is very imperfect, and the reflected light comes to the eye not from the entire surface, but from a number of separate points scattered over the surface.

When there is a total absence of luster the mineral is said to be **dull,** or **earthy.** Chalk, Kaolin, Yellow Ocher, etc., are examples.

7. Magnetic Properties: A few minerals, that contain considerable iron, are often magnetic, that is, particles can be picked up by a magnet. Native Iron, Magnetite, Pyrrhotite, etc., are examples.

8. Structure: Among minerals will be found a variety of structure. Most mineral specimens are aggregations of imperfect crystals. Even those whose structure to the naked eye appears destitute of crystallization, show under the microscope, that they are composed of very minute crystalline grains. Mineral structure may be conveniently divided under the following headings:

A. **Columnar and Fibrous Structure**—A mineral possesses a columnar structure when it is made up of slender columns, as some Amphibole. When the individuals are flattened like a knife blade, as in Cyanite, the structure is said to be **bladed.** The structure again is called **fibrous** when the mineral is made up of fibers, as in Asbestos, also the Satin Spar variety of Gypsum. The fibers may or may not be **separable.** There are many gradations between coarse columnar and fine fibrous structures. Fibrous minerals have often a silky luster. The following are varieties of columnar or fibrous structure:

Reticulated—when the fibers or columns cross in various directions and produce an appearance resembling a net. Example-Cerussite.

Stellated—when they radiate from the center in all directions and produce star-like forms. Examples-Stilbite, Wavellite.

Radiated, divergent—when the crystals radiate from the center without producing stellar forms. Example-Stibnite, Tourmaline.

B. **Lamellar Structure:** The structure of a mineral is lamellar when it consists of plates or leaves. The laminae may be curved or straight, and thus give rise to the **curved lamellar** (Ex. Talc), and **straight lamellar** (Ex. Biotite). When the laminae are thin and separable, the structure is said to be **micaceous** or **foliated.** Mica is a good example, and the term **micaceous** is often used to describe this kind of structure.

C. **Granular Structure:** when it is composed of crystalline grains. If the grains are large it is known as **coarse-granular,** as in some Sandstones; if small, it is said to be **fine-granular,** as in Marble. If the grains cannot be distinguished by the ordinary eye, the structure is said to be, **impalpable,** observed in certain kinds of Sphalerite. Granular minerals, when easily crumbled in the fingers, are said to be **friable.**

D. Miscellaneous Structure: when a mineral shows no crystal faces, altho it may possess a crystalline structure, it is said to be **massive.** Massive minerals, like ordinary Quartz or Chalcopyrite, are more often met with than well crystallized specimens.

Amorphous: when no traces of a crystalline structure exists, it is said to be amorphous. There are not many minerals that are truly amorphous, and they are not always easily distinguished from massive specimens. Opal, Amber, Obsidian (Volcanic Glass) are good examples.

Compact-Earthy: when it is composed of a uniform accumulation of exceedingly fine particles, as Kaolin, Bauxite, etc.

E. Imitative Forms: Minerals often assume the form or shape of well-known substances as follows:

Reniform: kidney-shaped, resembling an ordinary kidney, as some Hematites.

Botryoidal: resembling a bunch of grapes, as in Prehnite, Chalcedony, etc.

Mammilary: somewhat like botryoidal only much larger, as in Malachite.

Globular: if the surface is made up of little spheres or globules, as in Prehnite or Hyalite.

Nodular: when a mineral has irregular knots over its surface, resembling some potatoes, it is called a **nodule,** or is said to have a **nodular structure,** as in some Siderite.

Amygdaloidal: when a mineral or rock contain almond-shaped cavities, its structure is said to be **amygdaloidal,** as in some diabases.

Coralloidal: when a mineral takes the form of a delicate branching coral, as in certain varieties of Aragonite (Flos-Ferri).

Dendritic: branching out, like a branch on a tree, as Wad on Limestone.

Mossy: like moss in form and appearance, as in Moss-Agate.

Filiform or **Capillary:** consisting of very long and slender, thread or hair-like crystals ,as in Millerite.

Acicular: consisting of slender and rigid, needle-like crystals, as in Stibnite.

Reticulated, resembling a net. See Columnar structure.

Drusy: when covered with very fine crystals so that the surface is rough like sandpaper, as in some Quartz.

Concentric: if the layers in a mineral are arranged in parallel position, about one or more centers, the structure is said to be **concentric,** as in some Malachite.

Concretionary: when a mineral has formed about some foreign substance, enclosing same, it is called a **concretion.** Very common in clay beds.

Stalactitic: when a mineral occurs in icicle-like forms, it is called a Stalactite, as in some varieties of Limonite, Calcite, etc. The Calcite stalactites are found hanging down from the roofs of Limestone caves, and are formed from dripping water. Stalagmites are found on the floors of the caves, and are, likewise formed from dripping water.

9. Specific Gravity: Another property which is very important, especially, with some minerals, is specific gravity. Specific gravity is the weight of a mineral compared to the weight of some standard substance, generally water, size for size. For example, if the specific gravity of a mineral is given as 6, it means that that mineral is 6 times heavier than water, size for size. Tho specific gravity is an important property it is difficult to determine, unless, special equipment is available. In handling various minerals, it will be noticeable that certain minerals are much heavier than others, especially, if they are of the same size. Most minerals, containing an appreciable amount of iron, zinc, copper, nickle, lead, etc., are heavy, while coals, clays, asphalts, etc., are light. In other words, minerals containing metals, are heavier, than minerals containing non-metals.

10. Taste, Odor, and Feel: A few minerals can be determined or at least partly determined, by their action upon the senses, as follows:

Taste—**Saline**—taste of common salt, as Halite.

Alkaline—taste of common baking soda, as Natron.

Bitter—taste of Epsom Salts, as Carnallite.

Odor—**Alliaceous**—odor of garlic, obtained when Arsenopyite or other arsenic minerals are heated or else hammered quickly.

Sulphurous—odor of sulphur, obtained when minerals containing sulphur are heated. Pyrite, if hammered quickly, gives off this odor.

Bituminous—odor of bitumen, obtained when Asphaltum minerals are heated or else rubbed briskly.

Argillaceous—odor of moistened clay. Kaolin and other clays, generally, give off this odor, especially, if breathed upon.

Horse-radish Odor—is the odor of decaying horse-radish, obtained when selenium ores are heated.

Fetid—odor of hydrogen sulphide or rotten eggs, obtained from some varieties of calcite if rubbed briskly or else hammered.

Feel—is of importance in the case of a few minerals, such as Graphite, Talc, Molybdenite, etc. It will be readily recognized from the terms used to define it as greasy, smooth, gritty, harsh, soft, etc. Topaz, for example, is very **cold** to the touch. Certain minerals **adhere to the tongue** when brought in contact with it.

11. Transparency: The property of transmitting light that is possessed by most minerals to a greater or less degree, is termed transparency. Minerals are **transparent** when the outlines of objects viewed thru them are distinct; **Subtransparent** when objects are seen but have indistinct outlines; **translucent,** when light is transmitted but objects cannot be seen; **subtranslucent,** when merely the edges transmit light; and **opaque,** when no light is transmitted at all. In determining the transparency of an unknown mineral, always use a small, clean, and **thin** fragment.

12. Tenacity: The tenacity of a mineral is the persistency with which its particles cling together. This is different in different minerals, but, like hardness, is more or less constant for any one mineral. The different degrees of tenacity are as follows:

Brittle—when the mineral flies to pieces under a sharp blow, and powders under the edge of a knife in the attempt to cut it, as Galena.

Sectile—when pieces may be cut off with a knife without falling to powder, but the mineral still goes to pieces under the hammer, as in Gypsum. This is really a condition intermediate between brittle and malleable.

Malleable—when pieces can be cut off and these flattened out under a hammer without flying to pieces, as Gold, Silver, Lead, Copper, etc.

Ductile—when a mineral or parts of a mineral can be lengthened or drawn out and remain so. This is possessed to a remarkable degree by Gold, Silver, Iron and Copper.

Flexible—when a mineral can be bent without breaking, and remain bent after the bending force is removed, as Talc.

Elastic—when a mineral can be bent, but returns to its original position after the bending force is removed, as Muscovite.

13. Miscellaneous Properties:

Play of Colors—the term **play of colors** used to describe the appearance of several prismatic colors in rapid succession on turning the mineral, as in Precious Opal.

Change of Colors—the term **change of colors** is used when each particular color passes thru a larger space than in the **play of colors** and the succession produced by turning the mineral is less rapid, as in Labradorite.

Opalescence—is a milky or pearly reflection from the interior of a mineral. Observed in some Opals, and in Cat's Eye.

Chatoyancy—having a luster resembling the changing luster of the eye of the cat at night, as Tiger-Eye Quartz.

Iridescence—is the exhibition of prismatic colors in the interior or on the surface of a mineral.

Tarnish—a metallic surface is tarnished when its color differs from that obtained by fracture, as in the case of Bornite. This change of color results from being exposed to the atmosphere.

Dichroism—is the property of exhibiting different colors in different directions by transmitted light, as in some Epidote.

Asterism—is the name given to the peculiar starlike rays of light observed in certain directions in some minerals. Thin sheets of Phlogopite from South Burgess, Canada, if held in front of a small flame, will show this phenomena. Also observed in certain Sapphires, known as Star Sapphires.

Schillerization—the general term **schiller** (from the German) is applied to the peculiar luster, sometimes nearly metallic, observed in definite directions in certain minerals, especially in Schiller-Spar (an altered variety of Bronzite), also in Diallage, Hpersthene, Sunstone, etc.

Fluorescence—is the emission of light from within a mineral while it is being exposed to direct radiation, or in certain cases to an electrical discharge in a vacuum tube. It is best shown by Fluorite, from which the phenomenon gained its name. Thus, if a beam of white light be passed thru a cube of colorless Fluorite a delicate violet color is called out in its path.

Phosphorescence—some minerals when gently heated become luminous and emit light for a longer or shorter period. This property, known as **phosphorescence,** may be tested by heating fragments in a closed tube, and best in a dark room. Many varieties of Fluorite phosphoresce beautifully, with purple or green light. Some minerals phosphoresce when they are struck or rubbed; others after they are exposed to sunlight or to a electrical discharge.

Triboluminescence: is somewhat similar to phosphorescence. It has the property of giving off sparks when scratched (best seen in the dark). This is observed in certain varieties of Sphalerite.

Glowing—some minerals **glow,** or give off a bright light, when heated in-

tensely before the blowpipe. Calcites, Brucites, Zircons, etc., give this phenomena.

Pyroelectricity—some minerals when they undergo a change of temperature become **electric and** have the property of attracting light bodies. This property, known as **pyroelectricity,** is especially characteristic of crystals which show an unlike development at its opposite ends. Two kinds of electricity are always developed, positive at one end and negative at the other. To detect pyroelectricity a crystal is gently heated in a flame, and as it cools it is brought near some small bits of tissue paper, which will be attracted. Another experiment is to use a cat's hair which has first been rubbed between the fingers so as to become positively electrified—if brought near the cooling crystal the hair will be attracted by the negative end of the crystal and repelled by the positive end. A hair for this purpose may be fastened to a cork with sealing wax and kept in a small glass vial.

Alteration—is the change that a mineral undergoes due to atmospheric conditions. All minerals are effected by the weather, some so slowly as to be almost unchangeable, but many are easily altered. Pyrite, Marcasite, Realgar, etc., are some of the common minerals that easily become changed. Pyrite and Marcasite, are pale brassy-yellow sulphides of iron. Tho these minerals are heavy and hard, they soon become coated with a white powder (iron sulphate) and in a few months may fall completely to pieces. Not all Pyrites and Marcasites are so easily effected, as some can stand the weather fairly well. Realgar is the red sulphide of arsenic. It is so easily effected by the weather that it has to be kept in the dark, as light alone will change it into the yellow sulphide of arsenic, which is Orpiment.

Pseudomorphs—when a mineral alters or changes completely it passes into another mineral. This new mineral oftentimes takes the same shape or form as that of the original mineral. We call this new mineral so formed—a **pseudomorph** after the original mineral. Some common pseudomorphs are Limonite after Pyrite, Quartz after wood (Petrified Wood), Opal after wood (Opalized Wood), etc.

"MY HOBBY"

By Pearl Hamilton Elliott

I have a little hobby
  That's very dear to me;
Collecting rocks, and minerals,
  And coral from out the sea.
When days are dark and dreary
  And the cold "North Wester" blows:
I fly straight to my cabinet,
  And forget the biting snows.

When I'm tired and the world seems blue
  I drop my cares and toil;
To caress my many minerals,
  Lovely products of the soil.
All the colors of the rainbow
  Greet my eager eye,
As I open wide the cabinet
  With a joyful little cry.

Oh my darlings, how I love you,
  Pretty things, Nature's own;
Equal to the pearly dew,
  And the summer rose full blown.
Nature was sweetly generous
  When she made you, pretty things;
Altho, I think she copied your colors
  From the Butterfly's wings.

My specimens are from everywhere
  In this grand old world so strange;
I have even rocks of color,
  From the common cattle range.
But there's something strange about it
  That I can not understand,
My minerals seem to radiate
  A glow, from their native land.

Oh it's great to have a hobby,
  One like mine, I say;
Because it's educational
  And pleasure every day.
Then too, you gain much by it,
  For it keeps one young, you see;
And it's not expensive either
  Because, it's almost free.

NON SILBA SED ANTHAR.

Maplecrest Farm.
Middletown, N. Y.

PALEONTOLOGY DEPARTMENT

Conducted by

Benjamin T. Diamond

President of Geology Club of C. C. N. Y.

Mr. Diamond will gladly assist subscribers in identifying their fossil specimens or answering any questions pertaining to fossils. Please write to him direct, enclosing enough postage if a personal reply is desired, specimens returned, etc. Address all mail as follows: Mr. Benjamin T. Diamond, 467 Riverdale Ave., Brooklyn, N. Y.

AN INTRODUCTION TO FOSSILS

Benjamin T. Diamond

The object of this series of articles is to instruct the beginners in the study of paleontology and to interest others.

Paleontology, which literally means "science of ancient life," deals primarily with fossils.

A fossil is any body, or the trace of the existence of any body, whether animal or vegetable. which has been buried in the earth by natural causes. Footprints, trails, or burrows left by animals upon sand or mud are also included under the term fossils, though these objects were at no time parts of animals.

There are seven different natural conditions in which fossil remains are recognizable, three of which relate to substance, three to form and one to both.

Preservation of Fossils:

1. Preservation of the entire organism by freezing. Fossilization by this method is very rare, though remarkable examples are afforded by Mammoths and Rhinoceroses with flesh, hide and hair intact in the frozen soils in Siberia.

2. Preservation of the entire organism by natural embalmment. Fine examples are the perfectly preserved Insects in the famous amber of the Baltic Sea region. This amber is a hardened resin, the Insects having been caught in it while it was still soft and exuding from the trees.

3. Preservation of only hard parts of the organisms. This is a very common kind of fossilization in which the soft parts have disappeared by decomposition, while the hard parts, such as bones, shells, etc., remain.

4. Preservation of carbon only (carbonization). This is particularly true of plants where, as a result of slow chemical change or decomposition, the hydrogen and oxygen mostly disappear, leaving much of the carbon, but with the original structure often beautifully preserved. Many excellent examples are furnished by the fossil plants of the great coal age (Pennsylvanian).

5. Preservation of original form only (casts and molds). Fossils of this class, which are very abundant, show none of the original material; only the

shape or form has been preserved. When a fossil becomes embedded in sediment, which hardens around the entire organism or any part of it, and the organism decomposes, a cavity only is left and this is called a mold. A cast may be formed by filling a mold with some substance such as a sediment or mineral matter carried by underground water or by filling a hollow organism like a shell with some solid substance.

6. Preservation of the original form and structure (petrifaction). When a plant or hard part of an animal has been replaced, particle by particle, by mineral matter, we have what is called petrifaction. Petrified wood is a good example.

7. Preservation of tracks of animals. Footprints of animals made in moderately soft mud or sandy mud which soon hardens and becomes covered with more sediment, are especially favorable for preservation. Thousands of examples of tracks of great extinct Reptiles have been found in the red sandstone of the Connecticut River alone.

Significance of Fossils:

The value of fossils in the study of earth history is inestimable. They furnish most important evidence regarding earth chronology, ancient geographic and climatic conditions, as well as a basis for a proper understanding of the evolution relations and distribution of modern organisms.

Besides the identification of an ore bed by its physical character, it is in certain cases possible to recognize it by means of its contained fossils. This is the case, for example, with the Clinton iron ore of the Silurian rocks in New York. The fossils are the only sane evidence of identity in age, when the districts compared lie some distance apart.

I heard related that a French inspector of mines, M. Meugy, hearing of the discovery of phosphate of lime in a certain part of the Cretaceous in England and knowing from fossil evidence that beds of the same age existed in France, concluded that the French beds might also contain phosphate deposits—a conclusion which was amply verified.

For a long time the subdivisions of the Geologic column were made almost solely on the basis of marked difference in fossils, but it is now recognized that such differences were, in no small degree, caused by corresponding changes in the environment in which the organisms lived, or in other words, by changes in the climate, the topography, the relations of land and sea, etc. So now the geologic records are divided at the points where the revolutionary physical changes are indicated, and to make corresponding division of Geologic time itself. Thus, there are two kinds of divisions—one for the rocks themselves, and the other for the time represented by the rocks.

The following time and rock scales have been adopted by the International Geological Congress:

TIME SCALE	ROCK SCALE
ERA	GROUP
PERIOD	SYSTEM
EPOCH	SERIES
AGE	STAGE

TABLE OF MAIN GEOLOGICAL DIVISIONS

Era And Group	Period And System	
Cenozoic	Quatenary	
	Tertiary	
Mesozoic	Cretaceous	
	Jurrassic	
	Triassic	
Paleozoic	Permian	
	Pennsylvanian	Carboniferous
	Mississipian	
	Devonian	
	Silurian	
	Ordovician	
	Cambrian	
Proterozoic	(Algonkian	
Archeozoic	(Archean	

The name of the eras follow a definite plan depending upon the great life stages. Thus Archeozoic means literally "primitive or beginning life"; Proterozoic means "earlier or less primitive life"; Paleozoic means "ancient life"; Mesozoic means "intermediate life"; and Cenozoic means "recent life".

Next Issue—Directions for Collecting and Preparing Fossils.

IDENTIFICATION DEPARTMENT

To this department, subscribers may send in minerals to be identified—free. Only the common minerals will be identified at present, as we haven't the time or facilities to do any analyzing. Give name of locality where found with each specimen, and if minerals are to be returned, remit enough stamps for postage.

W. H. H., Vernon, B. C.—The specimen sent in is an impure limestone. Limestones are used as a flux in metallurgical plants; in the manufacture of cement; as crushed stone in road building; as a building stone; etc. Limestones are cheap, tho certain grades bring a higher price. If there are any sméltering plants in your vicinity you may be able to interest them in your deposit.

INQUIRY DEPARTMENT

Under this heading we will gladly answer questions pertaining to rocks, minerals, ores, etc., mining, geology, etc.

GLOSSARY DEPARTMENT

A list of various mining, mineralogical and geological terms, with explanation of each one. Free use has been made of the various publications on mining, mineralogy and geology, including bulletins issued by the U. S. Bureau of Mines and the U. S. Geological Survey. The Century, Standard and Webster dictionaries, have also been consulted.

Adamite—A honey-yellow hydrous zinc arsenate.

Adamsite—A greenish-black variety of common mica.

Adarce—A calcareous sediment of some mineral springs. A soft and porous saltish concretion on reeds and grass in marshy grounds in Galatia.

Adelaide ruby-Blood-red garnet (Pyrope) from South Africa.

Ader wax—Crude Ozocerite in leafy masses.

Adhesion—A molecular force by which bodies of matter are caused to stick together.

Adhesive slate—A very absorbent slate that adheres to the tongue if touched.

Adinole—A dense felsitic rock composed chiefly of an aggregate of excessively fine quartz and albite crystals, such that on analysis the percentage of soda may reach 10. Actinolite and other minerals are subordinate. Adinoles occur as contact rocks, associated with diabase intrusions and are produced by them from schists. (Compare Spilosite and Desmite). They also constitute individual beds in metamorphic series (Compare Porphyroid, Halleflinta). The name was first given by Beudant but has been especially revived by Lossen. (Kemp.)

Adit—A nearly horizontal passage from the surface by which a mine is entered and unwatered. In the United States an adit is usually called a tunnel, tho the latter, strictly speaking, passes entirely thru a hill and is open at both ends. Frequently also called Drift, or Adit level.

Adit level—See adit.

Adobe—A sun-dried brick; often shortened to adob and even 'dobe.

Adolescent river—In geology, a river in the second stage of a new drainage system, having a well-cut channel that may reach base-level at its mouth, and a graded bed, and having largely obliterated the lakes and waterfalls of its youthful stage. Its small tributaries may still be in the youthful stage.

Adular; adularia—A variety of orthoclase (feldspar). Transparent varieties are used as gems.

Advanced workings—Mine workings that are being advanced into the solid, and from which no pillars are being removed.

Advanced gallery—A small heading driven in advance of the main tunnel in tunnel excavation.

Adventive crater—A volcanic crater opened on the flank of a great cone.

Aeolian—An adjective applied to rocks formed of wind-borne sands. Some such aeolian sands yield large quantities of oil; practically all the big Baku spouters have been obtained from sands of this class.

Aeolian rocks—Fragmental rocks, composed of wind-drifted materials. The drift-sand rock, the common building stone of Bermuda, is a good example.

Aerial railroad—A system of cables from which to suspend cars or buckets, as in transporting ore.

Aerial tramway—A system for the transportation of material, as ore or rock, in buckets suspended from pulleys or grooved wheels that run on a cable, usually stationary. A moving or traction rope is attached to the buckets and may be operated by either gravity or other power, as determined by topographic features or other conditions.

(To be continued)